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Stroubles Creek at the StREAM Lab
http://bse.vt.edu/about/facilities/StREAM_Lab.html

The problem of legacy sediments:

$$\text{Inflow} - \text{Outflow} = \Delta\,\text{Storage}$$

Watershed + Upstream reaches

What we want to minimize

Floodplain deposits, including legacy sediments

↓

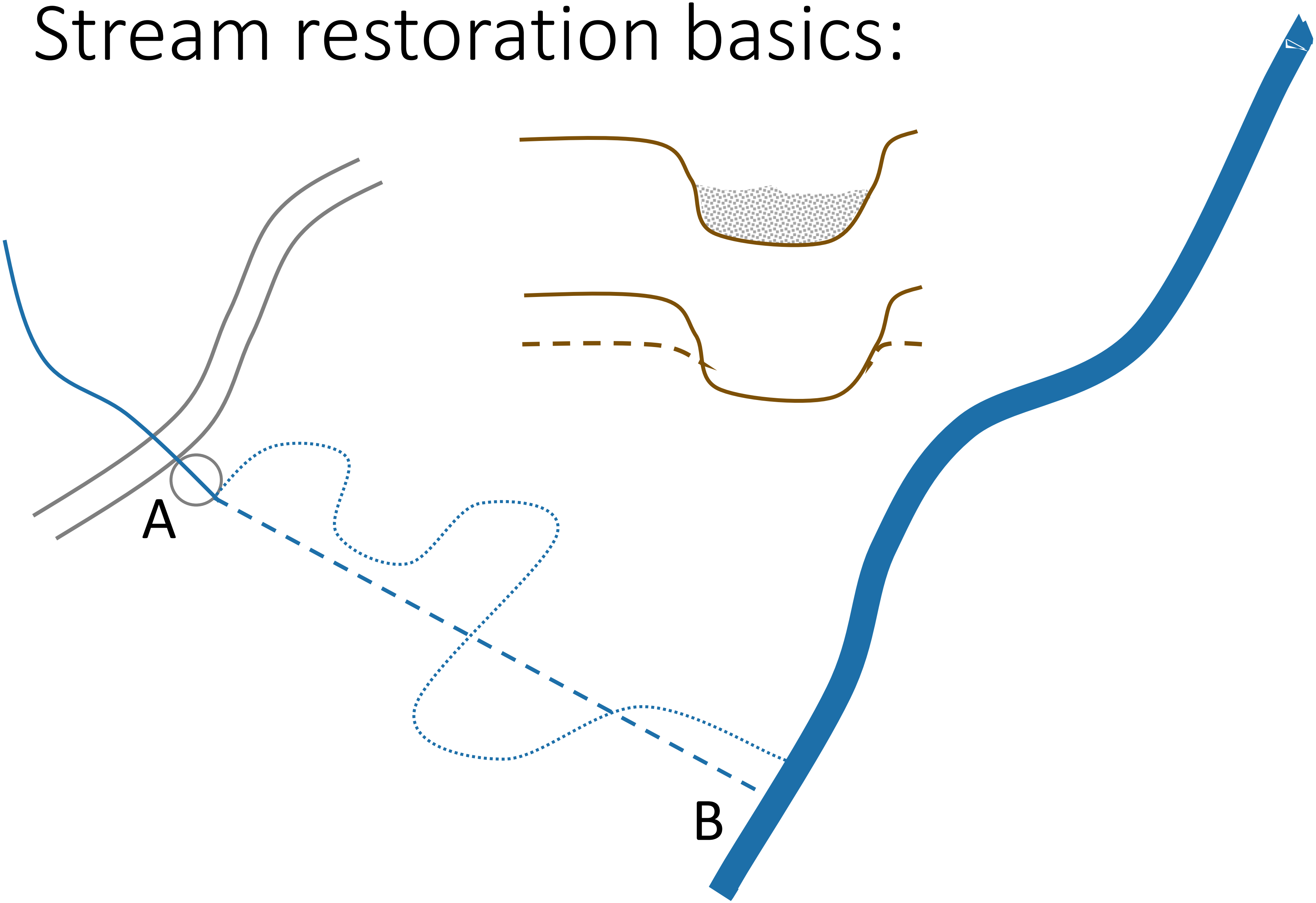
1. Leave in place
2. Remove

Can “stream restoration” projects reliably and effectively reduce channel erosion?

Yes*

*Assuming the stream restoration project was designed correctly, built correctly, and a flood of greater magnitude than the design flow (e.g. 100-yr flood) does not occur.

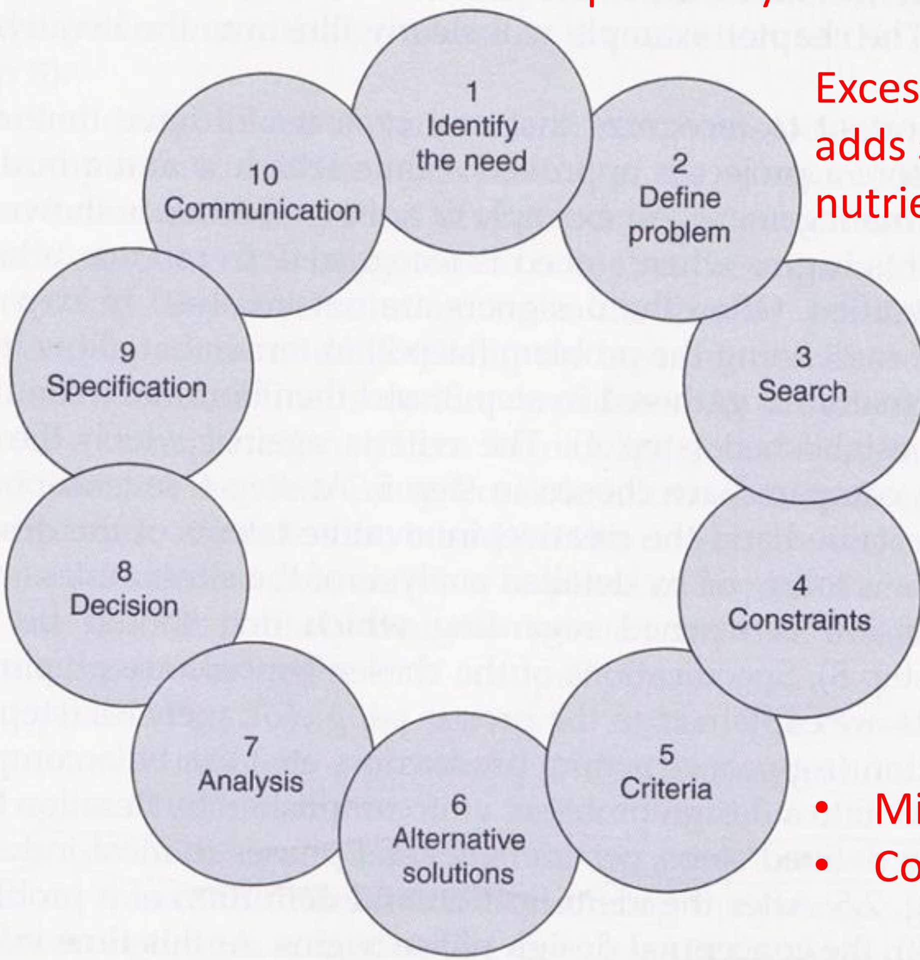
Stream restoration basics:



A view from behind the pocket-protector…

Improve Bay water quality

Excessive channel erosion adds sediment and attached nutrients to watershed



The design process is iterative in nature.

- Infrastructure protection
- Elevation of culverts, pipelines, bedrock, etc.
- Permit requirements

- Minimize tree removal
- Cost

http://www.thehiyl.com/2014/02/be-careful-what-you-wish-for.html

Clean Water Act Goal:
"restore and maintain the chemical, physical, and biological integrity of our nation's waters."

+

Streams are highly dynamic ecosystems.

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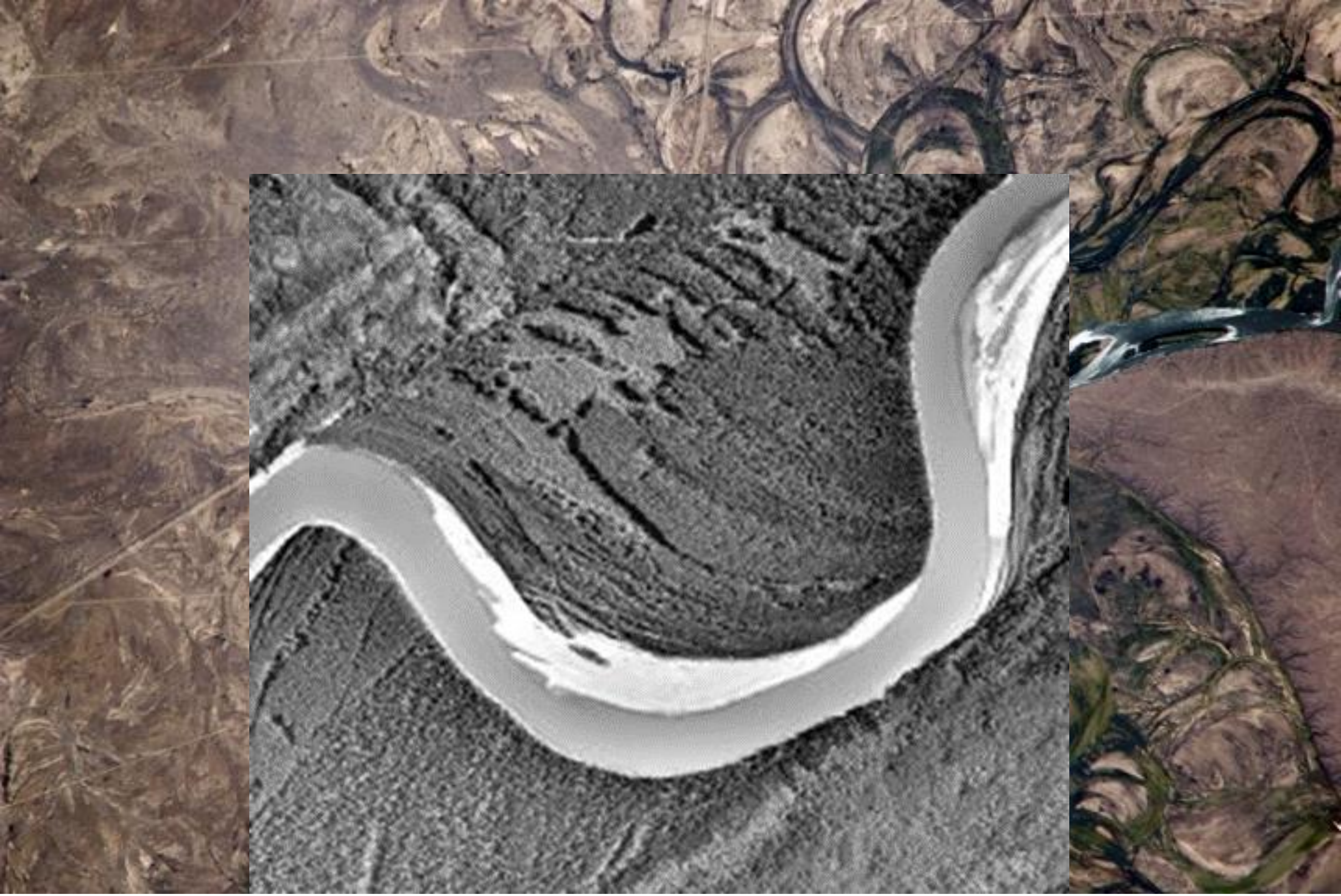
Healthy streams move.

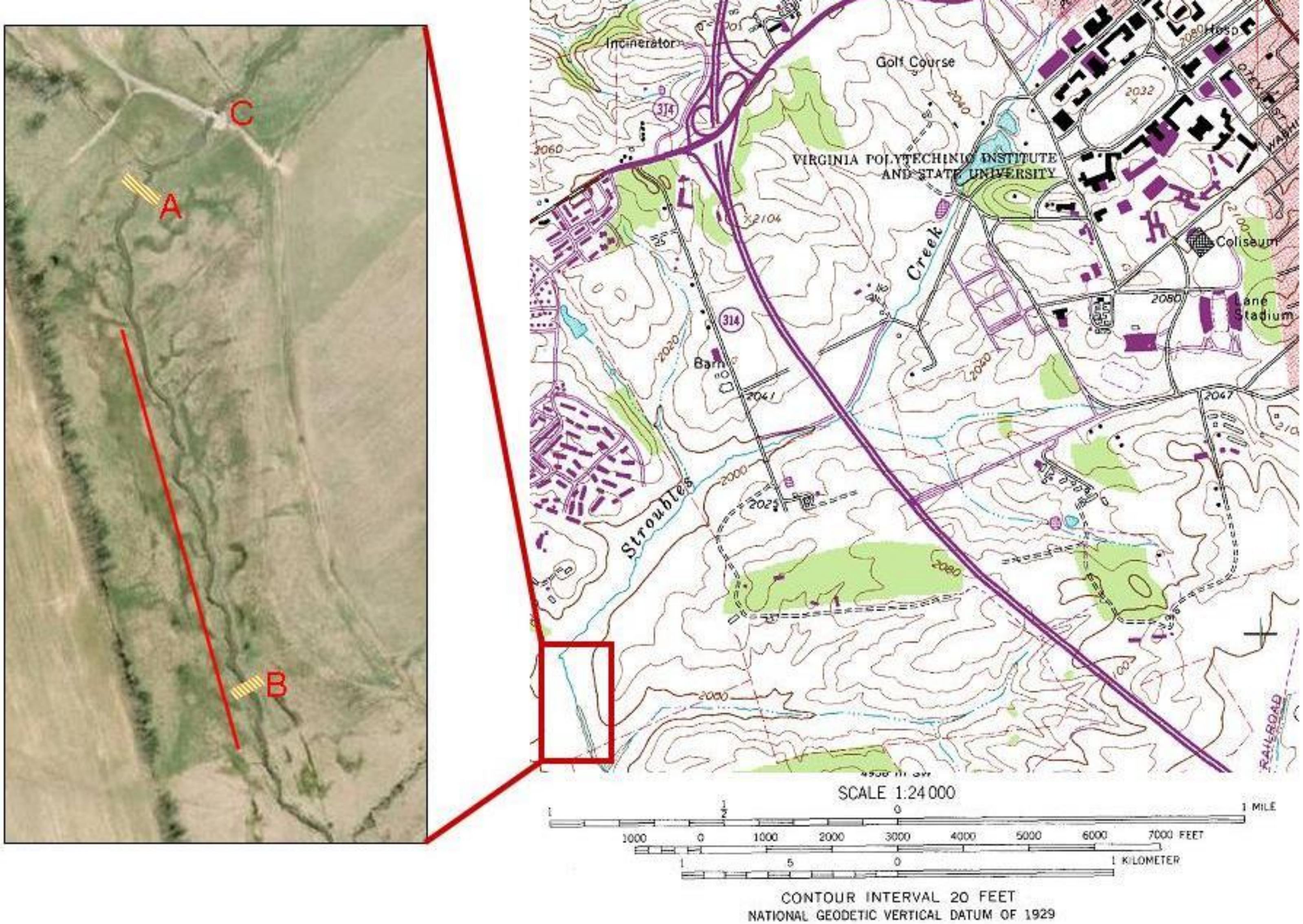


https://web.csulb.edu/~rodrigue/geog140/lectures/streams.html

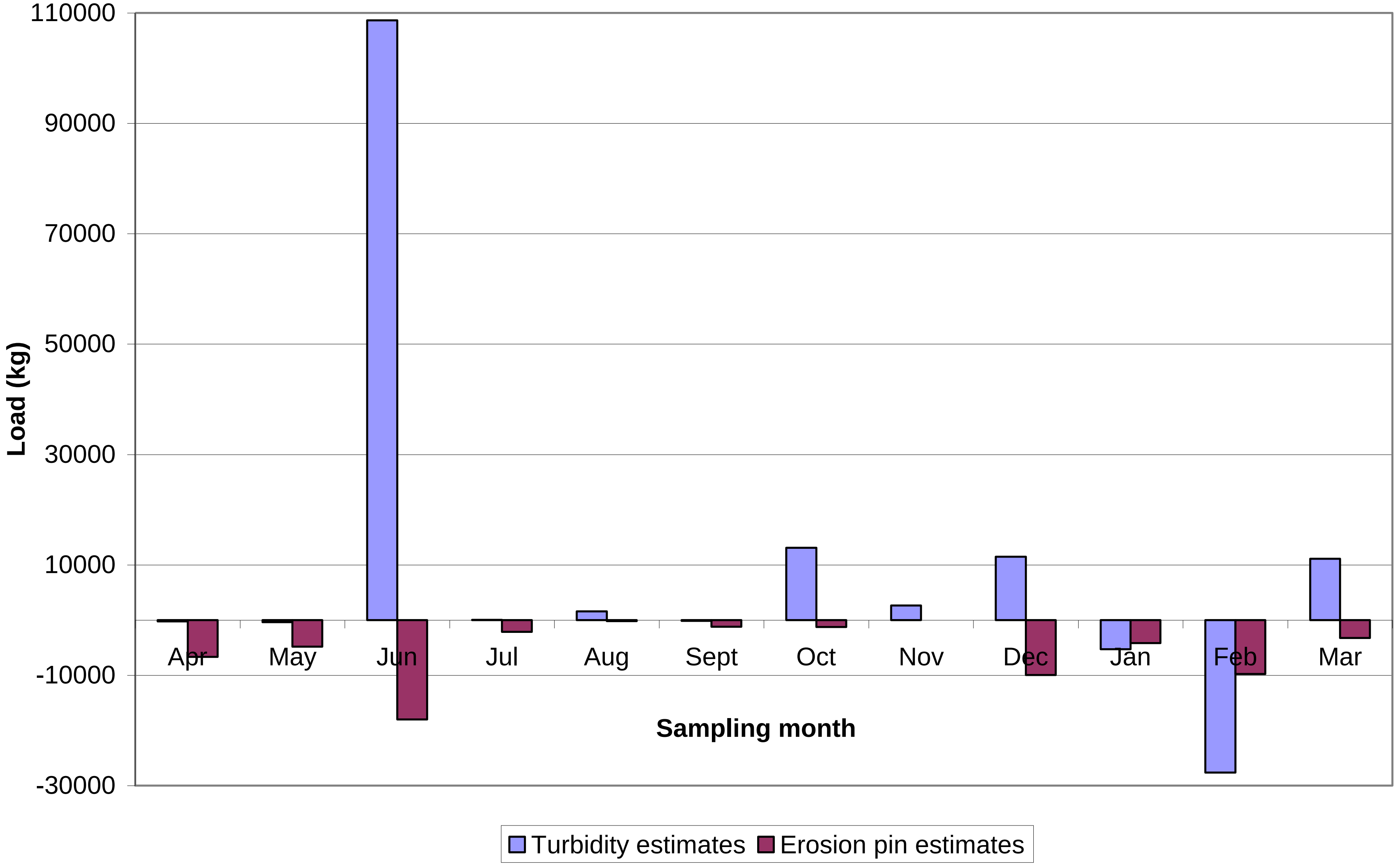
Meanders and oxbow lakes in the floodplain of the Rio Negro, Argentina. Image courtesy of NASA, 2010.

Final thoughts

- It is very difficult to develop an accurate sediment budget, particularly in small urban channels



The Stroubles Creek study site drains the town of Blacksburg, VA and the campus of Virginia Tech. The red line on the aerial photograph is 322 meters. Bridges A and B were each outfitted with two turbidity sensors and were the upstream and downstream locations for storm sampling. Bridge C is where the gaging station is located.



Monthly sediment loads generated within the study reach based on turbidity and erosion pin measurements from April 2006 to March 2007. Positive load means that sediment was deposited within the study reach, while negative load represents sediment lost from the reach. Pre-post topographic surveys showed 55 m^3 lost, although this is within survey error. Erosion pins showed 43 m^3 eroded from banks over same time period.

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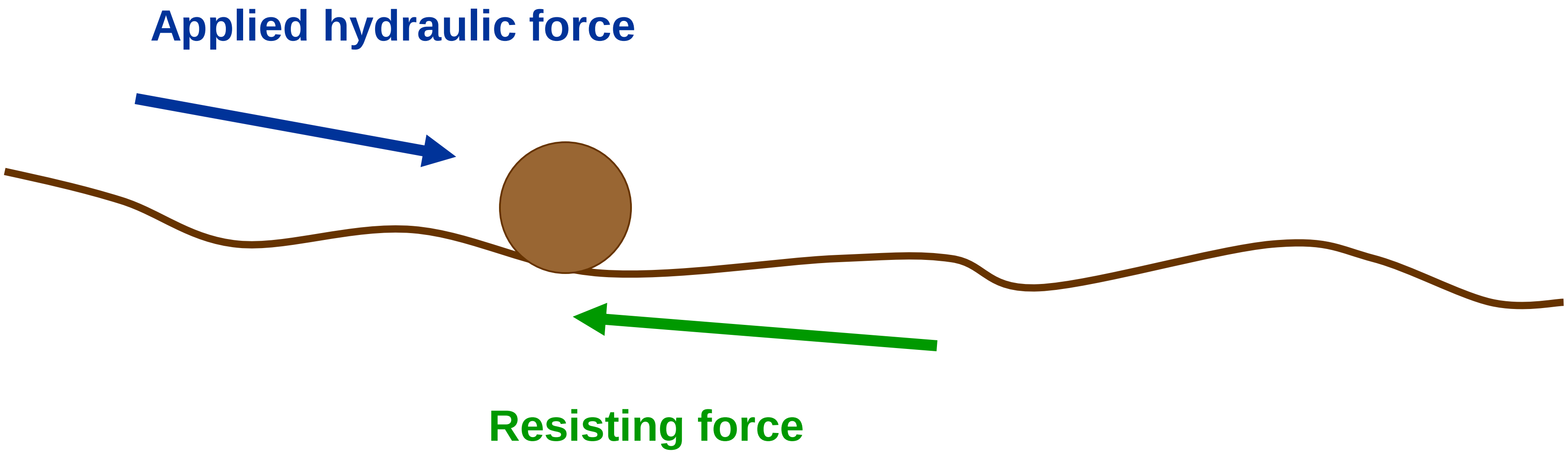
- In the end, you need to get water (and bedload?) from point A to point B
    - How depends on each particular situation

How does streambank erosion occur?



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  - The channel will change over time as trees grow

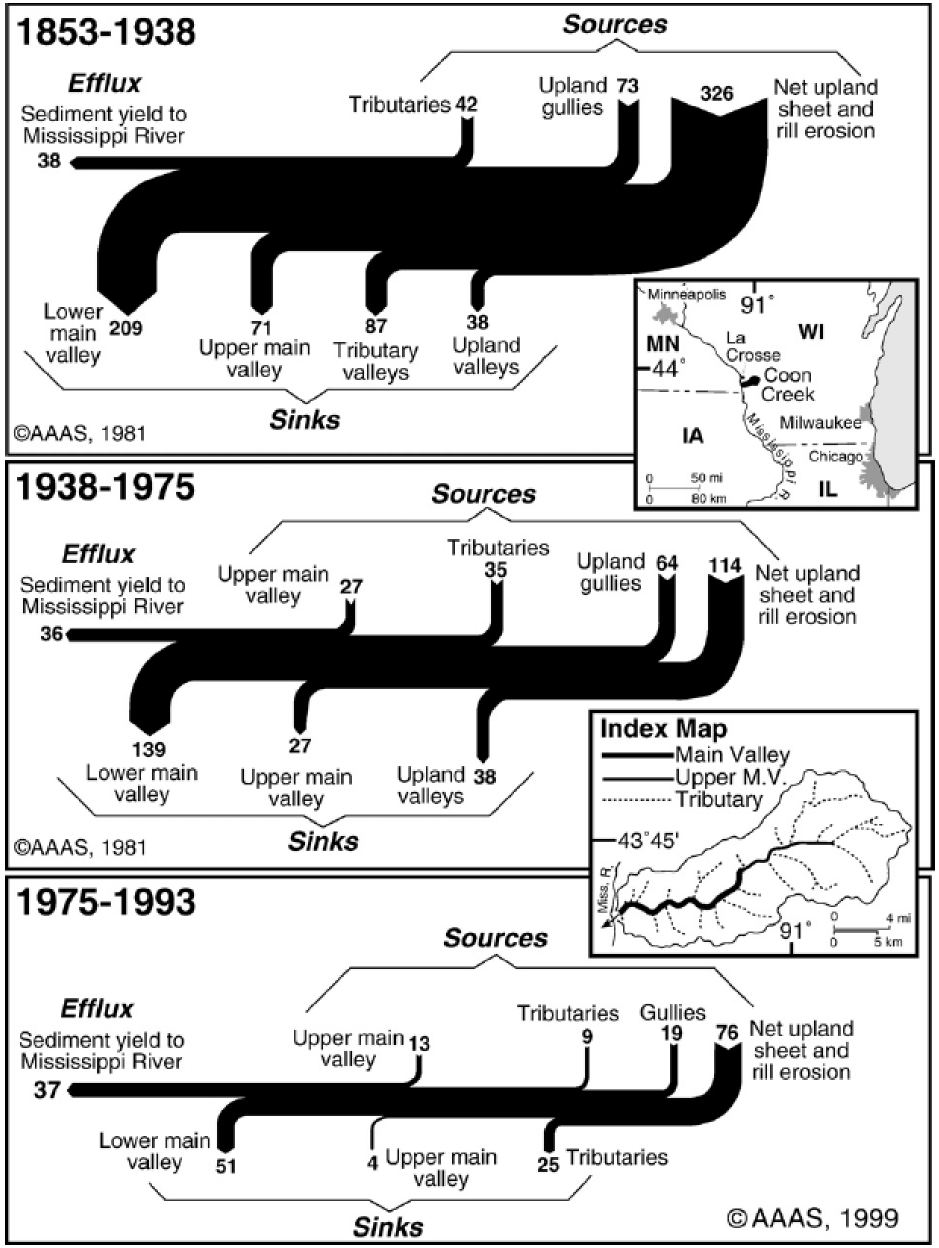
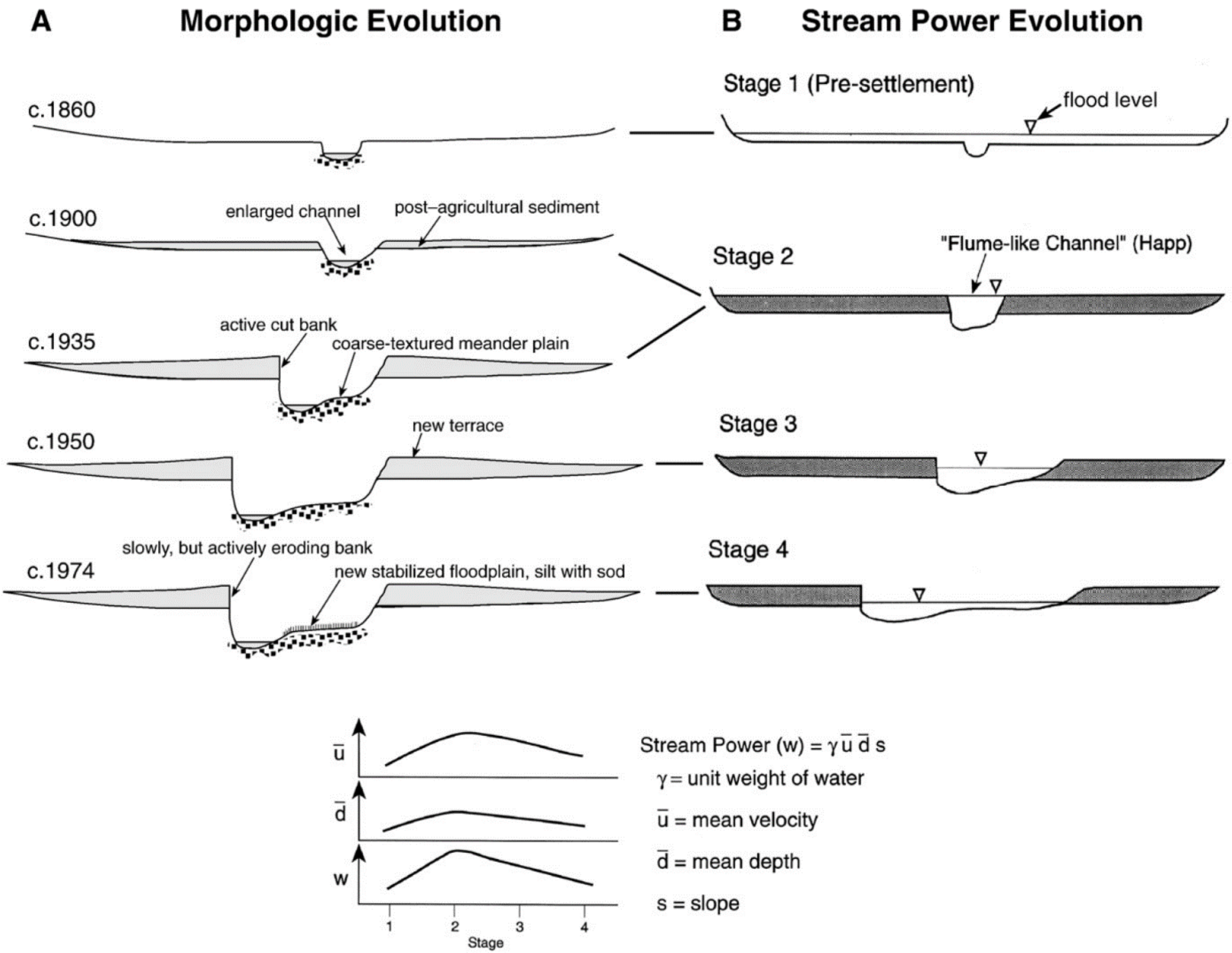
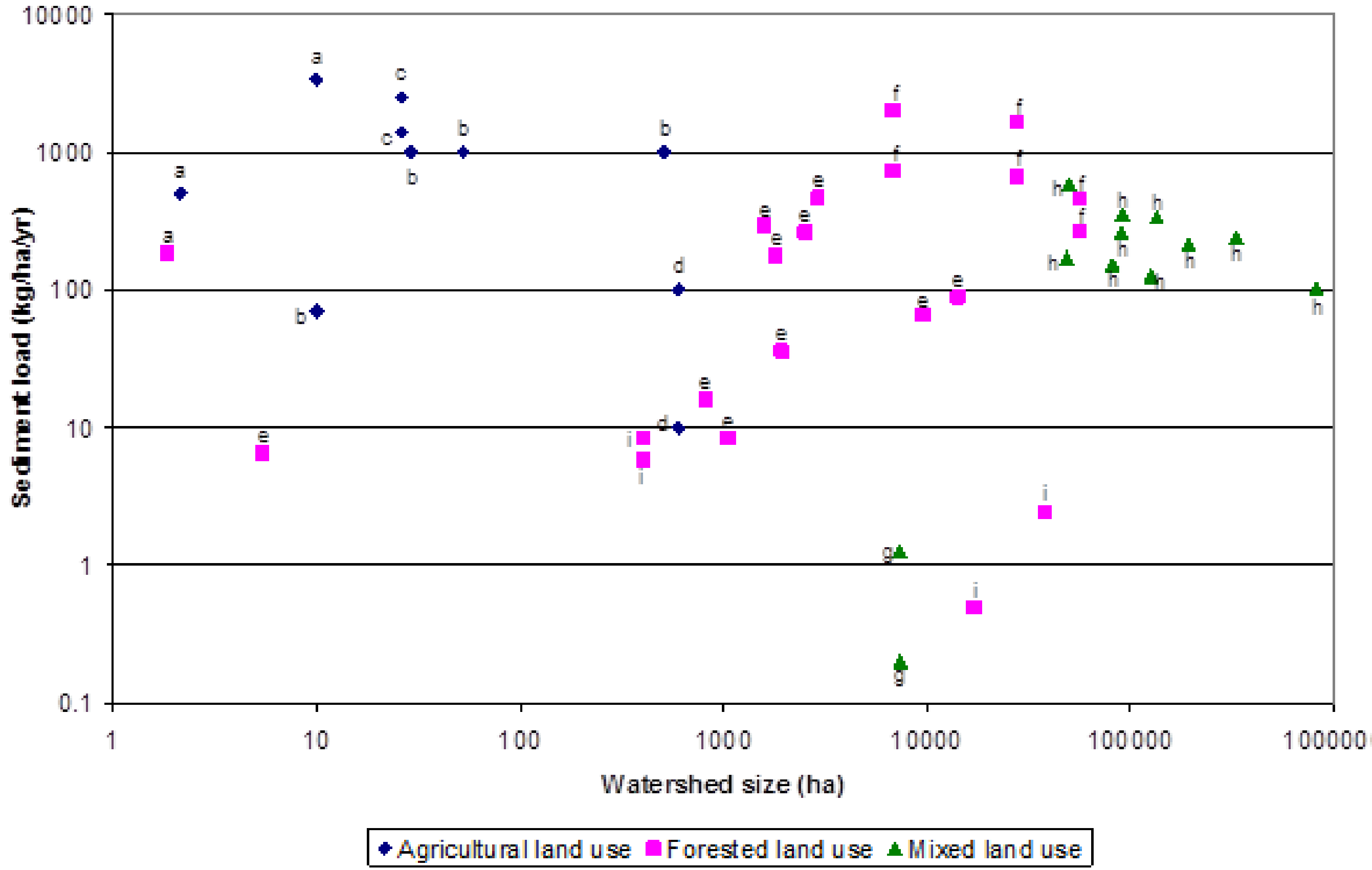


Fig. 1. Sediment budgets for Coon Creek Wisconsin, 1853 to 1993. This basin is about 25 km southeast of La Crosse, Wisconsin and has an area of 360 km^2. Numbers are annual averages for the periods in 10^3 Mg/year. All values are direct measurements except net upland sheet and rill erosion, which is the sum of all sinks and the efflux minus the measured sources. The lower main valley and tributaries are sediment sinks whereas the upper main valley has been a sediment source (Trimble, 1999).


A
Morphologic Evolution
B
Stream Power Evolution
c.1860
c.1900
enlarged channel
post–agricultural sediment
c.1935
active cut bank
coarse-textured meander plain
c.1950
new terrace
c.1974
slowly, but actively eroding bank
new stabilized floodplain, silt with sod
Stage 1 (Pre-settlement)
flood level
Stage 2
"Flume-like Channel" (Happ)
Stage 3
Stage 4
ū
d̄
w
1
2
3
4
Stage
Stream Power (w) = γ ū d̄ s
γ = unit weight of water
ū = mean velocity
d̄ = mean depth
s = slope



Sediment load verses watershed size from reported literature for agricultural, silvicultural, and mixed land uses: a. (Schreiber et al., 2001); b. (Armstrong and Mackenzie, 2002); c. (Owens et al., 1997); d. (McKergow et al., 2003); e. (Simon, 2008); f. (Uhrich et al., 2003); g. (Williamson et al., 1996); h. (Wass and Leeks, 1999); i. (Bull, 1997). Two data points for conventional tillage agriculture practices on small watersheds (<6 ha) from the Schierber et al., 2001 study were not included to improve figure clarity (11,073 kg/ha/yr and 19,273 kg/ha/yr).